III. REMARKS

1. Claims 19, 23-26, 35, 41 and 43 are amended. It is noted that the amendments to claims 23-26 are to correct the dependency of the claims and does raise any issues of estoppel.

2. An interview was held between the Examiner and Applicant on February 27, 2008. During the interview the arguments and amendments presented in Applicant's response dated December 21, 2007 were discussed. Rolling die design for ausforming powder metal gears according to Applicant's claims as compared to die designs for conventional powder metal gears and wrought steel gears were discussed. The nexus between the unexpected results presented by Applicant and the limitations in the claims were also discussed. The Examiner asserted and applicant concedes that the unexpected results presented by Applicant must be compared with the closest prior art, but for the reasons noted below Applicant respectfully submits that the cited references Amateau et al. (US 5451275, hereinafter "Amateau") and Sonti et al. (US 6779270, hereinafter Sonti) are not the closest prior art.

3. Claims 19-24, 27-30 and 47 are patentable under 35 U.S.C. 103(a) over Amateau and Cole et al. (US 5711187, hereinafter "Cole"). Claim 19 recites that each die has an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling. This feature is not disclosed or suggested by the combination of Amateau and Cole.

Amateau discloses something different than what is claimed by Applicant. Amateau discloses is that each rolling gear die (44, 46) has an outer peripheral profiled surface for rolling the gear

teeth surfaces of the workpiece (42) to a desired outer peripheral profiled shape (Col. 12, L. 64 - Col. 13, L. 2).

Combining Amateau with Cole does not remedy the above noted deficiency. Cole discloses that each rolling die is normally in the form of a mating gear made from hardened tool steel. In use the die is engaged with the sintered gear blank, as the two are rotated their surfaces are brought together to compact and roll the selected areas of the blank surface. When a predetermined axle spacing is reached, rotation at that spacing will usually continue for a given number of gear revolutions. (Col. 2, L. 42-62; Col. 3, L. 23-42). There are no other features of the rolling dies disclosed in Cole. Cole simply does not disclose or suggest that the resulting gear is a finished gear or that the dies have "an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling". Rather, the gears of Cole are subject to subsequent heat treatment and grinding processes to achieve the finished shape of the gear (See the Affidavit at page 4, item 5 submitted with Applicant's prior response dated September 10, 2007).

Thus, claim 19 is patentable over the combination of Amateau and Cole because neither reference, alone or in combination, discloses or suggests that each die has an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling. Claims 20-24, 27-30 and 47 are patentable over the combination of Amateau and Cole at least by reason of their respective dependencies.

It is respectfully submitted that the language in Applicant's claims that each die has an outer peripheral powder metal gear

tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling specifies a die design tailored for ausforming a powder metal gear. Neither Amateau nor Cole disclose this. As described above, Amateau is silent as to powder metal while Cole only discloses forming a conventional unausformed powder metal gear. It is noted that the die designs of Amateau and Cole are designed to perform different operations on the workpiece. For example, dies to ausform wrought steel gears are designed to plastically deform the surface layers of the gear blank without any volume change of the workpiece. The depth of the surface deformation when ausforming a wrought steel gear is less than about 0.0015 inches per flank (tooth thickness reduction is about 0.003 inches) where the die has to impart high lateral loads (and be able to withstand substantial elastic deflections of the gear/die teeth) to induce plastic deformation in the tooth surface. A die for forming a powder metal gear such as that disclosed in Cole is designed to densify the soft steel surface layers of the powder metal workpiece. No plastic deformation is performed in Cole and there are low elastic deflections of gear/die teeth as compared to the dies of Amateau. The tooth thickness reduction in Cole is up to about 0.010 inches. The die of Cole is also only designed for pre-finishing operations prior to heat treating the workpiece (i.e. subsequent grinding or other finishing is needed to finish shaping the gear teeth). The powder metal gear tooth finishing surface of the die claimed in Applicant's claims is designed to plastically deform and densify the surface of the gear teeth to form a tooth having a finished geometrical shape where no subsequent shaping is needed. The die in Applicant's claim is designed to create a tooth thickness reduction of about 0.006 inches. (See item 9, Sonti Declaration dated March 3, 2008).

Further, the gears produced by the methods claimed by Applicant have shown unexpected increases in durability over conventional powder metal gears. As described above it is noted that the unexpected results must be compared with the closest prior art, however it is respectfully submitted that gears formed by the methods/apparatus of Amateau are not the closest prior art. Applicant conducted research to improve the performance characteristics of powder metal gears. (See item 2, Sonti Declaration dated March 3, 2008, attached hereto; See also MPEP 716.02(c) and In re May, 574 F.2d 1082, 197 USPQ 601 (CCPA 1978)). It is to this goal that Applicant's claims are directed. Therefore, applicant has compared its unexpected results with a conventional powder metal gear such as that of Cole (i.e. what Applicant's deems to be the closest relevant prior art)(See MPEP 716.02(e) stating "Applicants may compare the claimed invention with prior art that is more closely related to the invention than the prior art relied upon by the examiner"; In re Holladay, 584 F.2d 384, 199 USPQ 516 (CCPA 1978; and Ex parte Humber, 217 USPQ 265 (Bd. App. 1961)). It is noted that comparison to wrought steel gears are also provided to show that the performance characteristics of the gears formed by the methods claimed are comparable to or exceed the performance characteristics of wrought steel gears.

It is also respectfully submitted that "although evidence of unexpected results must compare the claimed invention with the closest prior art, applicant is not required to compare the claimed invention with subject matter that does not exist in the prior art" (See In re Geiger, 815 F.2d 686, 689, 2 USPQ2d 1276, 1279 (Fed. Cir. 1987) (Newman J., concurring)). As described above a conventional powder metal gear would be the closest prior art. It is respectfully submitted that comparing the unexpected

results of the powder metal gear formed by the methods claimed by Applicant with an ausformed wrought steel gear produced by Amateau is an improper comparison especially when the goal of Applicant's research was to achieve a superior powder metal gear having performance characteristics comparable to wrought steel gears, not ausformed wrought steel gears (although it is noted that the performance characteristics of the ausformed powder metal gears are estimated as being comparable to the performance characteristics of the ausformed wrought steel gears). Comparing the unexpected results of the gears formed by the methods of Applicant's claim to an ausformed wrought steel gear would in essence be comparing apples and oranges as wrought steel gears and powder metal gears have significantly different properties.

The surface durability (i.e. pitting fatigue) of conventional powder metal gears (i.e. pressed, sintered, carburized, hardended and tempered) have a pitting fatigue life in the range of 30-40% of that of wrought steel gears (See *Evaluation of Skuffing Resistance of Powder Metal Gears in the FZG Back to Back Rig*, J. Mandel et al., International Conference on Powder Metallurgy and Particulate Materials, part 11, p. 43-57, June 2005, attached hereto; Figure 11 on page 51 shows comparative pitting fatigue data on gears). Conventional powder metal specimens including low density (pressed, sintered, carburized, hardended and tempered) specimens, specimens that have been selectively surface densified (per the method of Cole) and fully densified specimens (powder forged) have also been subjected to rolling contact fatigue tests. It is noted that the G-50 life at 2500 MPa for wrought steel specimens was about 4-6 million cycles. The surface densified and the fully densified powder metal specimens showed a G-50 life of about 1.7 to 2.8 million cycles (or about 50% of that of wrought steel specimens) (See *Rolling Contact*

Fatigue Performance of Contrasting Surface Densified, Powder Forged and Wrought Steel Materials, W. Jandeska et al., International Conference on Powder Metallurgy and Particulate Materials, part 12, p. 44-55, June 2005, attached hereto; Table 1 on page 47 and table 3 on page 53 shows rolling contact fatigue data for cylindrical specimens).

Surface durability tests on the gears produced by the methods recited in Applicant's claims have been conducted at the Applied Research Lab at Pennsylvania State University. These tests compared the pitting fatigue resistance of the ausformed powder metal gears as claimed by Applicant to wrought steel gears and powder metal forged (fully densified) steel gears. Applicant's ausformed powder metal gears showed about a 100% higher pitting fatigue G-50 life as compared to wrought steel gears, and a pitting fatigue G-50 life of over ten times higher than powder metal forged steel gears that had not been ausformed. The failure rate percentage of the ausformed powder metal fears formed by the methods of Applicant's claims is also unexpectedly better than both the conventional powder metal gears and the wrought steel gears. (See item 3, Sonti Declaration dated March 3, 2008).

Scoring tests were also performed on the ausformed powder metal gears formed by the methods claimed by Applicant. These scoring tests also showed unexpected improvements over wrought steel and conventional powder metal gears. The scoring tests showed that the scoring resistance (as measured by scoring temperature at equivalent loads and speeds) of the ausformed powder metal gears formed by the methods claimed in the present application increased by about 30°F as compared to wrought steel gears and

increased by over 60°F as compared to unausformed powder metal gears. (See item 4, Sonti Declaration dated March 3, 2008).

Bending fatigue tests were also performed on the ausformed powder metal gears formed by the methods claimed by Applicant as compared to wrought steel and conventional powder metal gears. During this test the ausformed powder metal gears showed about a 15% increase in bending fatigue strength over the unausformed powder metal gears. It is noted that the ausformed powder metal gears formed by the methods of the present application exhibited improved surface durability and scoring resistance while maintaining equivalent bending fatigue strength as compared to wrought steel gears. (See item 5, Sonti Declaration dated March 3, 2008).

Tooth impact test results were performed on the ausformed powder metal gears formed by the methods claimed in the present application. The ausformed powder metal gears were able to absorb more impact energy than wrought steel, which is an another aspect not achievable with conventional powder metal gears. (See item 6, Sonti Declaration dated February 29, 2008).

These exceptional and unexpected increases in performance and durability of the ausformed powder metal gears as claimed by Applicant can be attributed to the enhanced accuracy and surface finish of ausformed powder metal gears created by the powder metal gear tooth finishing surface of the dies claimed in the methods of the present application, as well as increased strength due to ausforming effects of Applicant's methods. (See item 7, Sonti Declaration dated March 3, 2008).

In addition, the unexpectedly better performance characteristics of the ausformed powder metal gears formed by the methods claimed

by Applicant as described above over conventional powder metal gears a cost analysis was performed by the Applied Research Lab to compare the ausformed powder metal steel gears and conventional wrought steel gears. It is noted that the cost analysis was performed for the wrought steel gears as these gears may be replaced by the ausformed powder metal gears formed by the methods of the present application as conventional powder metal gears do not possess the desired performance characteristics to replace the wrought steel gears.

The cost analysis showed that the manufacturing cost per piece to produce ausformed powder metal steel gears according to the methods claimed by Applicant was about 43% lower than the manufacturing cost per piece to produce conventional wrought steel gears of equivalent quality. Thus, forming a powder metal ausformed gear according to the methods claimed by Applicant shows a significant cost savings over a wrought steel gear having equivalent performance characteristics. (See item 8, Sonti Declaration dated March 3, 2008).

Thus, Applicant's claims are also patentable over the combination of Amateau and Cole based on the unexpected increases in performance and durability.

4. Claims 25 and 26 are patentable under 35 U.S.C. 103(a) over Amateau, Cole and "Applicant's Admitted Prior Art". It is submitted that because Amateau and Cole do not disclose or suggest all the features of Applicant's claim 19 (from which claims 25 and 26 depend) that the combination of Amateau, Cole and "Applicant's Admitted Prior Art" cannot as well. Thus claims 25 and 26 are patentable at least by reason of their respective dependencies.

5. Claims 31 and 32 are patentable are patentable under 35 U.S.C. 103(a) over Amateau, Cole and Torii et al. (US 4972735, hereinafter Torii). It is submitted that because Amateau and Cole do not disclose or suggest all the features of Applicant's claim 19 (from which claims 31 and 32 depend) that the combination of Amateau, Cole and Torii cannot as well. Thus claims 25 and 26 are patentable at least by reason of their respective dependencies.

6. Claims 35, 37-39 and 41-46 are patentable under 35 U.S.C. 103(a) over Sonti and Cole. Claim 35 recites that the rolling die has an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling. This feature is not disclosed or suggested by the combination of Sonti and Cole.

Sonti discloses something different than what is claimed by Applicant. Sonti discloses that each rolling die has a plurality of teeth (42) and an outer peripheral contoured surface (44) extending between generally parallel spaced lateral surfaces (46, 48) (Col. 4, L. 48-51).

Cole, as described above, merely discloses that that each rolling die is normally in the form of a mating gear made from hardened tool steel (Col. 2, L. 42-62; Col. 3, L. 23-42). There are no other features of the rolling dies disclosed in Cole. Cole simply does not disclose or suggest that the resulting gear is a finished gear or that the dies have "an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling". Rather, the gears of Cole are subject to subsequent heat treatment and grinding processes to achieve the finished shape of

the gear (See the Affidavit at page 4, item 5 submitted with Applicant's prior response dated September 10, 2007).

Thus, claim 35 is patentable over the combination of Sonti and Cole because neither reference, alone or in combination, discloses or suggests that each die has an outer peripheral powder metal gear tooth finishing surface configured to substantially finish the powder metal surface of each tooth during rolling.

Claim 35 is also patentable over Sonti and Cole for the additional reason that the gears of Applicant's claims proved to have unexpected increases in performance and durability as described above with respect to claim 1.

Claims 41 and 43 are patentable over the combination of Amateau and Cole for reasons that are substantially similar to those described above with respect to claim 35. Claims 37-39, 42 and 44-46 are patentable over the combination of Amateau and Cole at least by reason of their respective dependencies.

For all of the foregoing reasons, it is respectfully submitted that all of the claims now present in the application are clearly novel and patentable over the prior art of record, and are in proper form for allowance. Accordingly, favorable reconsideration and allowance is respectfully requested. Should any unresolved issues remain, the Examiner is invited to call Applicants' attorney at the telephone number indicated below.

The Commissioner is hereby authorized to charge payment for one additional dependent claim and any fees associated with this communication or credit any over payment to Deposit Account No. 16-1350.

Respectfully submitted,

March 4, 2008

William J. Knotts, Jr.
Reg. No. 53,145
Date

Perman & Green, LLP
425 Post Road
Fairfield, CT 06824
(203) 259-1800
Customer No.: 2512

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being transmitted electronically on the date indicated below and addressed to Mail Stop Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: 4March2008

Signature: Frances J. Snow

Fran Snow
Person Making Deposit